

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27

TITLE

Improved Powered Clamp Application Tool

CROSS-REFERENCE TO RELATED APPLICATION

The present application is a continuation in part claiming priority to non-provisional application number 09/982,420 filed 10/17/2001.

FIELD OF INVENTION

The present invention relates to a band application and cutting machine that pulls one end of a band loop around a workpiece via a powered jaw and then cuts the band via a powered cutter.

BACKGROUND OF THE INVENTION

The industrial applications for winding a metal band or hose clamp around a workpiece such as a hose to secure the hose to a pipe or fitting are well known in the art. One mechanical system is disclosed in U.S. Pat. No. 5,918,866 (1999) to Klimach. A metal band is wound around a workpiece, and then the two ends of the band are fed into two receiving ports on a manually operated strap clamping tool. The clamp is tightened under the effect of a double pulley.

The closest known prior art is made by Band-It-Idex, Inc., a Unit of IDEX Corp., Denver, CO, model Ultra-Lok®,

1 see FIGS. 1 and 2 herein. Models include an AC or a battery
2 powered unit. The unit only handles a one size $\frac{3}{4}$ " specialty
3 clamp made by Band-It™. The clamps can be preformed with
4 the special buckle integral, or free-end with the special
5 buckle separate from the band. Either hose or pole
6 applications can be handled.

7 Referring to FIGS. 1, 2 an AC unit 1 has a housing 2
8 which includes a commercial drill motor with integral gear
9 box. The gear box powers a pulling assembly 3. The pulling
10 assembly 3 has a pulling element 4. The gear box powers a
11 screw 6 which pulls the pulling element 4 rearward during
12 the clamp tightening cycle.

13 In operation a tail of the band to be applied is
14 inserted into the band entry port 7 and gripped by the
15 gripper 5 inside the pulling element 4. Next the gear box
16 is powered to pull the pulling element 4 rearward via the
17 screw 6. Next the cutoff arm 8 is manually pulled forward
18 to form a locking dimple on the tail and then to cut the
19 tail.

20 FIG. 2 shows a battery powered unit 20 which functions
21 identically to unit 1.

22 Problems with the Band-It™ units include the limitation
23 of use with Band-It's expensive custom clamps, only
24 available in a $\frac{3}{4}$ " width.

1 of band widths, wherein the bands are of a generic off-the-
2 shelf design.

3 Another aspect of the present invention is to provide a
4 portable DC power tool that has a bench mount capability for
5 production runs.

6 Another aspect of the present invention is to provide
7 the power tool with the flexibility to handle both pre-wound
8 and free end clamps.

9 Another aspect of the present invention is to provide
10 the power tool with a pair of band grippers, one member to
11 pull the band for a tightening operation, and the other
12 member to automatically hold the tightened band in
13 preparation for the cutting operation.

14 Another aspect of the present invention is to provide a
15 portable clamp application tool which applies prewound steel
16 clamps and by adding an attachment will apply free end
17 clamps as well.

18 Another aspect of the present invention is to provide
19 an apparatus to manually release each gripper via a lever.

20 Another aspect of the present invention is to provide
21 an automatic front and rear gripper release assembly.

22 The tool consists of 12V DC electric motor and clutch-
23 gearbox coupled to a reduction gear get, which actuates a
24 threaded nut incorporated into the reduction gear, which
25 rotates around a threaded rod. The rod is attached to a

1 gripping mechanism which pulls the tail of the clamp through
2 a uniquely designed holding pressure mechanism which
3 automatically provides the precise holding pressure required
4 when the clamp is rolled 90° and the excess tail cutoff.
5 Furthermore the act of resetting the pulling gripper
6 automatically cuts the excess from the clamp and requires no
7 hand actuation of a cutoff mechanism.

8 This tool can be operated portably with a small battery
9 power supply. This allows the operator to go into the field
10 and apply hose clamps without having compressed air or AC
11 electricity available. The tool is of light enough weight
12 to allow bringing the tool to the job as opposed to the
13 present system which demands that the job be brought to the
14 tool. This tool can also be operated as a bench tool with
15 foot operated control, either by drawing its power
16 requirements from a battery or a power supply, which
17 operates from 110V AC. This versatility allows the tool to
18 be operated portably by hand, or mounted to the rear of a
19 service truck, or as a bench-mounted tool in the shop. This
20 is the first application tool, which is portable, battery
21 powered and features adjustable tension control, which will
22 apply the full range of clamps from ¼" to ¾" as well as
23 apply free end clamps.

24 Incorporated into the device is a pair of spring loaded
25 serrated gripping elements which are essentially free in one

1 direction and which when the product, which is being fed
2 under them in one direction is reversed, one element firmly
3 and repeatably moves a controlled distance before gripping
4 the fed product positively. The distance, which the product
5 moves before being positively gripped, is controlled by the
6 angle of the inclined plane against which the gripping
7 element moves.

8 This device is very useful for preformed clamp
9 application tools in as much as much as it replaces the
10 complex valving, gaging and plumbing which is presently
11 being used in application tools to accomplish the necessary
12 holding pressure when applying preformed host clamps.

13 Other aspects of this invention will appear from the
14 following description and appended claims, reference being
15 made to the accompanying drawings forming a part of this
16 specification wherein like reference characters designate
17 corresponding parts in the several views.

18

19 **BRIEF DESCRIPTION OF THE DRAWINGS**

20 FIG. 1 (prior art) is a side perspective view of an AC
21 powered Ultra-Lok® Band Clamping System.

22 FIG. 2 (prior art) is a side perspective view of a battery
23 powered Ultra-Lok® Band Clamping System.

24 FIG. 3 is a side perspective view of the alternate
25 embodiment clamp applicator system.

1 FIG. 4 is a rear perspective view of the foot controller
2 shown in FIG. 3.

3 FIG. 5 is a side perspective view of the clamp applicator of
4 FIG. 3 in the portable DC mode.

5 FIG. 6 is a rear plan view of the forward housing (600) of
6 the disassembled gear box housing.

7 FIG. 7 is a front plan view of the rear housing (502) of the
8 gear box.

9 FIG. 8 is a top plan view of the clamp applicator shown in
10 FIG. 3.

11 FIG. 9 is a longitudinal sectional view of the clamp
12 applicator taken along line 9-9 of FIG. 8.

13 FIG. 10 is a rear perspective view of the clamp applicator
14 showing the tension setting knob.

15 FIG. 11 (prior art) is a top perspective view of a preformed
16 clamp on a workpiece.

17 FIG. 12 is a front perspective view of the clamp of FIG. 11
18 being fed into the entry port of the clamp applicator
19 of FIG. 3.

20 FIG. 13 is a right side partial cutaway view of the clamp
21 being inserted into the entry port of the clamp
22 applicator of FIG. 3.

23 FIG. 14 is the same view as FIG. 13 with the clamp fully
24 inserted into the two grippers and ready for the
25 application procedure.

1 FIG. 15 is the same view as FIGS. 13, 14 with the pulling
2 gripper fully extended rearward.

3 FIG. 16 is the same view as FIGS. 13, 14, 15 with the
4 pulling gripper reversed back to its forward position,
5 the holding gripper has maintained the tension on the
6 taught band, the operator has manually pushed the clamp
7 downward, and the cutting jaw has rotated clockwise to
8 complete the powered cutting procedure.

9 FIG. 17 is the same view as FIGS. 13, 14, 15, 16 showing the
10 cutting procedure completed.

11 FIG. 18 is a top perspective view of the first step of a
12 free end clamp procedure, where the free end clamp has
13 been manually wound around a post, anchored at one end
14 to a buckle, with the free end of the band about to be
15 fed into the entry port of the free end adapter on the
16 clamp applicator.

17 FIG. 19 is a top partial cutaway view of the next step after
18 the FIG. 18 step, where the free end of the band is
19 partially fed into the clamp applicator.

20 FIG. 20 is the same view as FIG. 19 showing the free end of
21 the band fully inserted past the two grippers.

22 FIG. 21 is the same view as FIGS. 19, 20 showing the pulling
23 gripper fully extended rearward.

24 FIG. 22 is the same view as FIGS. 19, 20, 21 showing the
25 pulling gripper reversed and returned back to its start

1 position, and the clamp applicator (rather than the
2 post) has been manually rotated clockwise to bend the
3 free end into the locked position in the buckle in
4 preparation for the cutting procedure which is almost
5 completed.

6 FIG. 23 is the same view as FIGS. 19, 20, 21, 22 with the
7 cutting procedure complete.

8 FIG. 24 is a top plan view of the shear plate on top of the
9 tool.

10 FIG. 25 is a side plan view of the gripper in partial
11 cutaway.

12 FIG. 26 is a back plan view of the gripper.

13 FIG. 27 is a bottom plan view of the gripper.

14 FIG. 28 is a side plan view of the preferred cutter jaw
15 having one near side and one far side attached spurs to
16 open the gripper 902.

17 FIG. 29 is a top plan view of the cutter jaw.

18 FIG. 30 is a bottom plan view of the cutter jaw with spur
19 able to open the adjacent gripper.

20 FIG. 31 is a side partial cutaway view of the cutter jaw
21 spur disengaged from the gripper.

22 FIG. 32 is the same view as FIG. 31 with the cutter jaw spur
23 engaged with the gripper allowing the band to be
24 withdrawn from the gripper.

1 FIG. 33 is an exploded view of the improved automatic front
2 gripper release assembly.

3 FIG. 34 is a side cutaway view of the improved automatic
4 front and rear gripper release assembly also showing
5 the manual release levers, the preferred embodiment.

6 FIG. 35 is a top exploded view of the improved gripper
7 housing and cutter.

8 FIG. 36 is a side cutaway view of the rear gripper manual
9 release lever.

10 FIG. 37 is a side plan view of the improved automatic
11 release lever mounted on the cutter.

12 Before explaining the disclosed embodiment of the
13 present invention in detail, it is to be understood that the
14 invention is not limited in its application to the details
15 of the particular arrangement shown, since the invention is
16 capable of other embodiments. Also, the terminology used
17 herein is for the purpose of description and not of
18 limitation.

19

20 DESCRIPTION OF THE PREFERRED EMBODIMENT

21 Referring next to FIG. 3 a universal clamp application
22 system 3000 is shown. For portable use a battery pack 3001,
23 is plugged into the application module 3002 at handle 3003.
24 The application module is detached from the bench mount 3004
25 and fully operational.

1 The bench mount 3004 is attached to a working surface
2 3005. For bench mounted operation power to the application
3 module can either come from the battery pack 3001 or the
4 AC/DC power supply 3006 which is plugged into wall power.
5 The AC/DC power supply 3006 feeds DC power via cord 3007 to
6 the foot control module 3008.

7 For AC use the foot pedal 3012 activates DC power to
8 card 3010 which is plugged into socket 3011. The adapter
9 3009 receives the cord 3007.

10 For bench mount DC operation the adapter 3009 is
11 replaced with a battery pack 3001.

12 For applying a generic clamp assembly, the tail of the
13 band is inserted into band entry port 70. Internal
14 assemblies in the application module 3002 grip the tail,
15 pull the tail to the correct tension. The operator then
16 bends the clamp 90°, and finally the application module is
17 reversed and in a powered mode cuts the tail from the clamp.

18 Referring next to FIG. 4 the foot pedal module 3008 has
19 the pedal 3012 with a pivot at P so that the dotted position
20 R controls the reverse direction of the application module
21 3002 which is used in the cutoff operation. The tightening
22 operation is controlled by the left position shown in solid
23 lines. Depressing the pedal 3012 in direction ON powers the
24 application module 3002.

1 Referring next to FIG. 5 the application module 3002 is
2 ready to operate in portable DC mode. The battery pack 3001
3 is plugged into the handle 3003. The trigger 504 controls
4 power to the unit. The switch 505 controls forward, neutral
5 and reverse modes of operation. In the tightening mode the
6 tail of the band is pulled in direction T inside slot 503.
7 In the cutoff mode the switch 505 is set to reverse. When
8 the trigger 504 is activated and the automatic cutoff
9 operation is consummated as noted below.

10 The gear box 502 powers the screw 500 in a known
11 manner. To allow for variable pulling tension on various
12 width bands, a tension adjustment knob 501 is set for each
13 band width. A known variable clutch assembly varies the
14 transmitted power from the motor to the gear box 502 and
15 ultimately to the non-rotating screw 500.

16 Referring next to FIG. 6 the housing 502 has been
17 removed to disclose the base 600, primary gear 602 and
18 secondary gear 601.

19 Referring next to FIG. 7 the thrust bearing 700 can be
20 seen seated at the rear end of the gear box cover 502, screw
21 hole 563 being shown empty. A primary gear shaft support
22 bearing 701 is seen. A second thrust bearing (not shown)
23 rests against the opposite side of the secondary gear 6d.

24 A bolt 692 passes through holes 691 and then 690, and
25 similar bolts secure members 502 and 600 together as shown.

1 Referring next to FIG. 8 the slot 503 is clearly shown
2 on top of the clamp applicator 3002. The rest of the top of
3 the top front of the tool consists of a shear plate 805
4 which has a clearance channel 806. This clearance channel
5 806 may be about the depth of a typical band to allow the
6 band and workpiece to allow the band and workpiece to be
7 drawn up against the shear plate 805 as shown in FIG. 14.
8 The reaction plate 803 and bolts 804 structurally support
9 the moving gripper.

10 The main housing 844 may be made of aluminum or other
11 preferably lightweight material. A channel 801 accommodates
12 the non-rotatable screw 500. Bearings 800 are supporting
13 the nut gear shift assembly.

14 Referring next to FIG. 9 the air vents 939 in the
15 housing 844 allow the motor and primary gear box assembly
16 909 to cool. The primary gear shaft 908 turns the primary
17 gear 602. The tail 999 of clamp is shown manually inserted
18 into the entry port 70 and past both the stationary gripper
19 902 and the movable gripper 901. When the trigger 504 is
20 activated, the movable gripper 901 moves rearward in
21 direction tighten "T" by means of the non-rotating screw
22 500. For the cutting operation the switch 505 is set to
23 reverse, and the movable gripper 901 is moved back where it
24 started, and the movable gripper 901 releases its grip on
25 the tail 999 in the reverse direction. But in the reverse

1 direction the stationary gripper 902 engages the tail 999 to
2 prevent an unwinding of the tightened clamp. FIG. 9 shows
3 the cutter 903 in the neutral position, held there by the
4 return spring 904. The movable gripper 901 consists of a
5 housing 905 which contains a band exit port 929. When the
6 movable gripper 901 returns to the forward position, the
7 loose tail 999 slides out the band exit port 929.

8 FIGS. 10-17 show the entire operational sequence for
9 the application of a preformed clamp 1100 around a workpiece
10 1101. Preformed clamp consists of a tail 999 which is part
11 of a continuous band 998, wherein a buckle anchors both ends
12 of the continuous band 998 when the application is complete.

13 First the operator adjusts the torque adjustment knob
14 501 to the width of the band 998. If the torque on the
15 movable gripper 901 is too strong, then the band 998 would
16 yield and finally snap.

17 Next the tail 999 of FIG. 11 is inserted into the port
18 70 of the clamp applicator 3002 as shown in FIGS. 12, 13, 14
19 until the buckle 997 rests against the clearance channel 806
20 of shearplate 805. The tail 999 must pass through both
21 grippers 901, 902 as shown in FIG. 14.

22 FIG. 15 shows the movable gripper 901 powered in
23 direction T, which has tightened the clamp 1100. In FIG.
24 16, the clamp 1100 has been manually rotated

1 counterclockwise in direction BT, thereby locking the band
2 998 into the buckle 997.

3 Next in FIG. 16 the operator has reversed the direction
4 of movement of movable gripper 901 so as to return the
5 movable gripper 901 to its starting position. The tail 999
6 has exited the band exit port 929.

7 The cutter 903 has been pivoted around pivot 1605 by
8 means of the inclined plane forward edge 1602 of the movable
9 gripper housing 905, which has pushed the roller 1601 of the
10 cutter 903 downward. The roller 1601 has an axle 1600.

11 Fig. 17 shows the completion of the cutting cycle where
12 the cutter 903 has engaged the buckle moving it and the
13 captured tail 999 upward thereby shearing the tail 999
14 against the shear portion of the stationary gripper 902
15 housing 805, and the workpiece 1101 falls free from the
16 clamp applicator 3002.

17 Referring next to FIGS. 18-23 the application sequence
18 for a free end clamp 1850 applied around a pole P is shown.
19 The clamp applicator 3002 is the same but for the addition
20 of the free end clamp adapter 1800, preferably with four
21 bolts 1801. An extension entry port 1802 extends the entry
22 port for tail 9090 about one inch out from entry port 70.

23 The prior art free end clamp 1850 consists of a band
24 1860 where a first end is anchored via a hand bent tab 1852
25 to the buckle 1851. The tail 9090 slides through the buckle

1 1851 and then is manually fed into the extension entry port
2 1802. At the completion of the cutting operation which uses
3 the shear element 1844 to brace the clamp, the lock tabs
4 1853 are hammered down onto the tail 9090.

5 In FIGS. 19, 20 the tail 9090 is being manually
6 inserted past both the grippers 901, 902.

7 FIG. 21 shows the movable gripper 901 powered in
8 direction T to tighten the free end clamp 1850 which has
9 been pulled snug against the extension opening 1802.

10 Next the operator rotates the clamp applicator 3002
11 clockwise in order to bend the tail 9090 into a locked mode
12 on the buckle 1851 and prepare for the cutting operation.

13 FIG. 22 shows the same cutting operation with cutter
14 903 as described in FIG. 16. In this case there is left a
15 one inch lock tail 9999 at the end of tail 9090.

16 FIG. 23 shows the completed cutting operation. The
17 lock tail 9999 has been hammered down onto the buckle 1851.
18 The lock tabs 1853 need to be hammered down to complete the
19 application.

20 Referring next to FIGS. 24-27 the stationary gripper
21 902 is shown where FIG. 24 shows the top which is the shear
22 plate 805 with gap (clearance channel) G. Bolts 2400 hold
23 the gripper 902 together.

24 FIG. 25 shows the base 2505 holding the gripper body
25 2500. The gripper body 2500 has a pocket 2501 in which

1 rides the jaw 2502. The bottom 2506 of the jaw 2502
2 consists of an arcuate surface having small teeth to grip
3 the bands. The jaw 2502 slides up or down inclined plane
4 2525 to allow the bottom 2506 to grip and release the bands.
5 The movable gripper release pin 2504 engages the jaw 2502
6 gripper and releases the excess tail from the movable
7 gripper assembly when the tool is reversed and fully at the
8 end of its travel. A spring 2503 holds the jaw 2502 against
9 the top of the base 2505, and jaw 2502 is displaced rearward
10 and upward to allow the band to slip under it. The band
11 rides in gap G in the top of base 2505.

12 FIG. 27 shows the limits or width of the track 2700 in
13 which rides the band which is gripped by the bottom 2506 of
14 the jaw 2502. Cutter arm housing 2505 supports the cutter
15 arm 903, and provides the reaction surface for the gripper
16 902. Shearing edge 2801 shears the clamp in the cutting
17 operation.

18 Referring next to FIGS. 28, 29, 30, the spurs 2800 on
19 the cutter 903 push the jaw 2502 loose from the band just
20 after the cutting edge 2801 cuts the band. This allows the
21 tail of the band 9090 to be removed and discarded.

22 Referring next to FIGS. 23, 31, 32 the jaw 2502 slides
23 along an angled surface 3100 of the pocket 2501. The angle
24 L is preferably 20°. The angle L is chosen to allow the
25 band B to move forward a tiny bit (.010-.030 inch) when the

1 cutting operation begins and the movable gripper 901 moves
2 forward. This tiny slack releases the considerable tension
3 which exists between the clamp/workpiece and the shearplate
4 805. This tiny slack allows the manual bending of the clamp
5 in preparation for the cutting operation, and eliminates
6 complex known holding mechanisms.

7 FIGS. 31, 32 show how the spur 2800 moves the jaw 2502
8 back to allow release of the excess band B after the cutting
9 operation.

10 Referring next to FIGS. 33-37, the new and improved
11 manual gripper release levers 5,7 are pivotally mounted at
12 5009, 700 respectively. They each have a hook 501, 701
13 respectively which lift the grippers 901, 902 respectively
14 when the user raises the levers 5,7 as shown in dots in FIG.
15 34. The grippers 901,902 rise up to compress their
16 respective mounting springs 9010, 9020. This manual release
17 is desirable in case the operator inserted a clamp
18 incorrectly into the port 70. The improved clamp applicator
19 is denoted 30029, the preferred embodiment.

20 The improved automatic gripper release works as
21 follows. The screw 500 moves the gripper housing 905
22 forward after the clamp has been tightened. The function of
23 mobile gripper release pin is to automatically contact and
24 release the mobile gripper 901 at the end of its forward
25 travel.

1 The cutter (also called the mobile shear actuator) 903
2 is pivotable around pivot 4002 such that its tail 9033 moves
3 downward D as pushed by the tapered front edge 3469 of the
4 gripper housing 905. The automatic gripper release lever 3
5 is also pivotable around pivot 4002. The roller 1601 has an
6 axle 9039. As the screw 500 moves the gripper housing 905
7 forward, the automatic release lever actuators 4 also move
8 forward. The automatic release lever actuators 4 have a
9 forward pin 4000 that contacts recess 4001 of the automatic
10 gripper release lever(s) 3, thereby rotating the automatic
11 gripper release lever(s) 3 clockwise as shown by arrow C in
12 FIG. 37. The top and rear facing tip 3769 of the automatic
13 gripper release lever(s) 3 each push the stationary gripper
14 901 backward against spring 9010 as the gripper housing 905
15 reaches the end of its forward travel. Mounting screws 4111
16 secure the automatic release lever actuators 4 to the
17 gripper housing 905.

18 The function of 3 and 4 is to release the stationary
19 gripper 902 automatically, when the mobile gripper 901 is
20 very near the end of its travel which must occur after the
21 mobile shear actuator 903 has removed the tail of the
22 smallest width clamp, i.e. $\frac{1}{4}$ ".

23 Partial Parts List:

- 24 1. Mobile gripper HSG -1 required.

- 1 2. 903 Cutter (also called the Mobile shear
- 2 actuator)-1 required.
- 3 3. Gripper release lever, automatic-2 required.
- 4 4. Release lever actuator, automatic-2 required.
- 5 5. Manual gripper release lever-1 required.
- 6 6. Mobile gripper release pin, automatic-1 required.
- 7 7. Manual gripper release lever-1 required.

8 Although the present invention has been described with
9 reference to preferred embodiments, numerous modifications
10 and variations can be made and still the result will come
11 within the scope of the invention. No limitation with
12 respect to the specific embodiments disclosed herein is
13 intended or should be inferred.

14